TACTILE CONTROL DEVICE FOR A REMOTE SENSING DEVICE

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The invention relates to a tactile control device. More particularly, this invention relates to a tactile control device which is used as a remote sensing device for a fiberscope.

In many cases, it has been desirable to examine internal organs, passages and the like of the human body for purposes of diagnosis, biopsy, and polyp removal in preparation for surgery without cutting open the patient. An examination of intestine prior to surgery can enable a surgeon to better prepare for what he encounters at operation. The benefits of a prior visual examination without surgery are obvious. One method of examining the internal organs of the patient without major surgery is to insert a remote sensing device such as a fibroptic endoscope into the body through a natural body orifice or a specially prepared surgical opening.

The use of remote sensing devices for internal examination is not limited to medicine. Remote sensing devices can be used to examine the interior of otherwise inaccessible mechanical structures without opening them; such as aircraft wings, the walls of buildings, the enclosed areas of any structure. In these cases, an internal examination, without putting a major opening in the structure, can help to determine the reason for mechanical failure or the level of corrosion levels.

When using a remote sensing device, a common problem arising in medical or mechanical applications is to be able to maneuver the inspection end of the device around obstructions to the proximity of the area of interest. In the past, this maneuvering has been by a trained operator who will see the obstruction and then hazard a guess as how to direct the device safely around the obstruction. Such a mode of operation without the benefit of binocular depth perception is time consuming. Particularly undesirable in medical observation, is that the prolonged presence of the remote sensing device in the body and the frequent occurrence of excessive pressure of contact on an internal organ can result in damage or perforation at sites most often along the course of the instrument in no way related to the visualized area. In more recent times, use has been made of fiberscopes which allow viewing around bends. These fiberscopes are generally constructed with an elongated flexible insertion tube having a distal end in which an illuminating and viewing system is mounted and a proximal end in which a control unit is mounted for controlling the bending of the tube at the distal end. In many cases, the control unit employs four control cables and two turning knobs to direct the distal end in any one of four directions, i.e., up, down and side-to-side. The illuminating and viewing system usually employs glass fiber optic devices to transmit light to the distal end while allowing viewing of the surrounding environment at the distal end. To this end, the control unit is usually connected to a source of light and carries an eyepiece for viewing purposes.

Generally, when using a fiberscope of the above type, for example for inspection of a colon, the distal end is inserted into a patient via the rectum and is then guided through the colon. In order to direct the distal end and the trailing flexible tube through the colon, the user views through the eyepiece in the control unit. Should the colon turn, the user manipulates the turning knobs of the control unit to bend the distal end up, down, left or right so as to follow the bend of the colon.

However, since the colon follows a tortuous path, the walls of the colon can fold over so as to define bends of 90° or more. In cases where a distal end of a fiberscope reaches such a bend, a "red out" condition is presented. That is, the distal end abuts against the colon wall so that the user cannot see the direction in which the colon is bent. As a result, the user must then withdraw the tube inflate further with air or carbon dioxide and experiment with the turning knobs to determine which direction is the correct one to follow. In some cases, aggravated bendings of the distal end of a fiberscope may tear or otherwise damage the colon wall. In still other cases, use is made of expensive external equipment to determine the direction in which the distal end should be directed.

Accordingly, it is an object of the invention to provide a remote sensing device which can be relatively easily maneuvered around obstructions.

It is another object of the invention to provide a remote sensing device to ease medical examination of internal organs through natural body orifices.

It is another object of the invention to determine that the pressure of the instrument against the wall of an organ in no area exceeds the tensile strength of that organ.

It is another object of the invention to provide a remote sensing device for internal examination that will automatically provide data to detect obstructions and provide information for avoiding the obstruction.

It is another object of the invention to provide a tactile control device which can be incorporated into existing fiberscopes.

Briefly, the invention provides a tactile control device which comprises a flexible hood, made for example of a flexible digital foam, for circumferentially surrounding a distal end of a flexible tube of a fiberscope and a plurality of pressure-sensitive sensing devices which are mounted inside the hood for emitting a directional signal in response to pressure from flexing of the hood. In addition, a plurality of contact points can be located along the course of the fiberscope inside a pressure-sensitive covering to prevent lateral torque of the colonoscope from causing, for example, a lateral rupture of the wall of a bowel.

The tactile control device is particularly adapted to function with a fiberscope. For example, the tactile control device may be used with a fiberscope including an elongated flexible insertion tube, an illuminating and viewing system mounted at a distal end of the tube and a control unit for bending the tube at the distal end in two planes. In this case, the flexible directional sending hood is mounted over the distal end so as to circumferentially surround the illuminating and viewing system. In addition, the hood is disposed to project forwardly of the distal end so that the sensing devices are disposed circumferentially forward of the distal end. Upon an inward flexing of the hood, the sensing devices are able to emit a signal indicative of the location of the flexed section of the hood. These signals, in turn, can be used to activate the control unit of the fiberscope in order to direct the distal end in a direction away from the area of greatest pressure.

The sensing units consist of inside contact points with wires running along the instrument inside the pressure sensitive covering, for example a digital foam layer, to